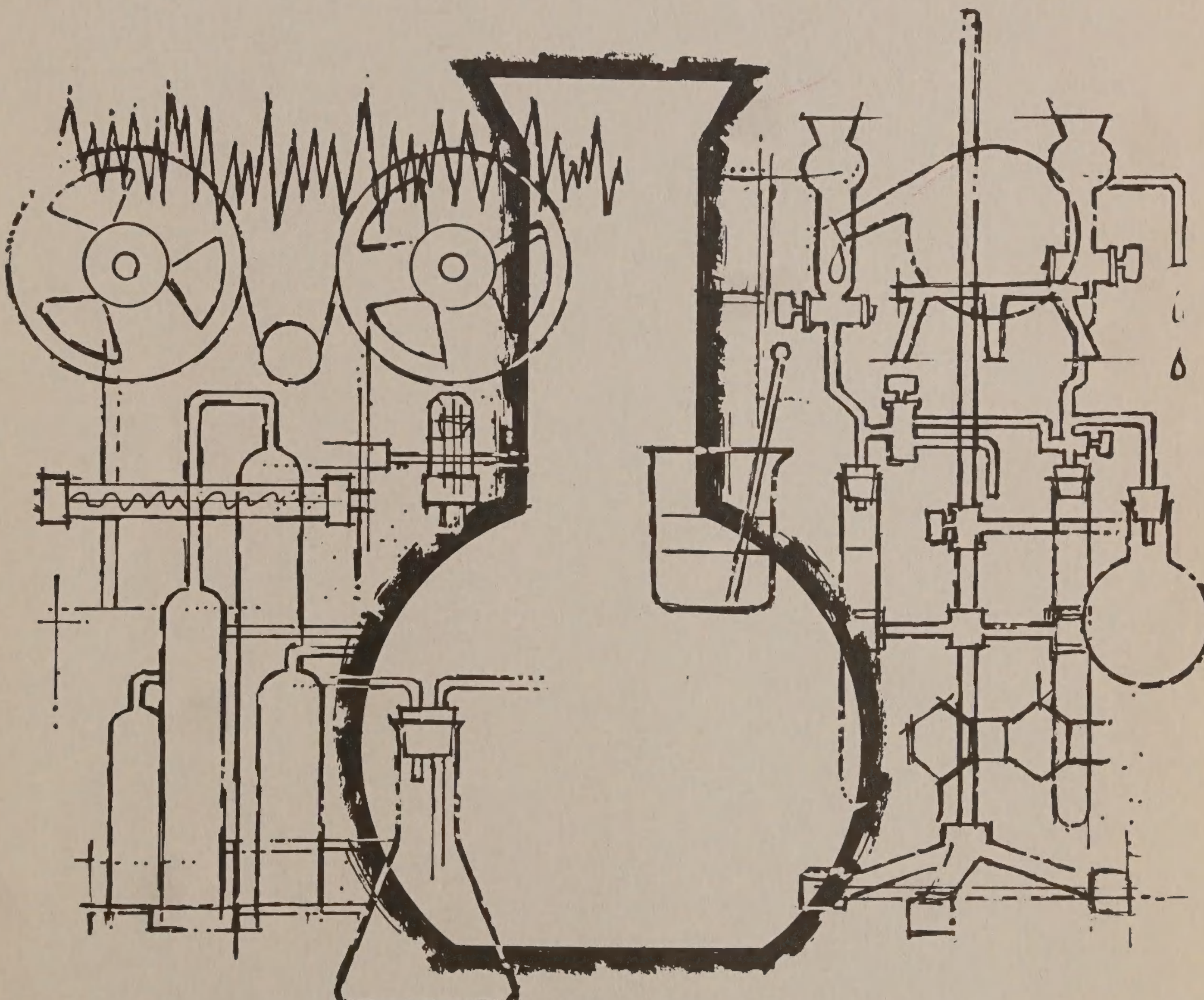
United States
Department of
Agriculture

Forest Service
Southern Region

Draft Environmental Impact Statement

VEGETATION MANAGEMENT in the Coastal Plain/Piedmont RISK ASSESSMENT SUMMARY



April 1988

SUMMARY OF THE DRAFT RISK ASSESSMENT FOR THE USE OF HERBICIDES IN USDA FOREST SERVICE REGION 8

This risk assessment is about potential effects on human health, wildlife, and aquatic species that could result from the use of 14 herbicides and herbicide adjuvants in vegetation management programs on national forests and national grasslands in the Southern United States (Forest Service Region 8). The herbicides are 2,4-D, 2,4-DP, dicamba, fosamine, glyphosate, hexazinone, imazapyr, picloram, sulfometuron methyl, tebuthiuron, and triclopyr. The herbicide adjuvants are kerosene, diesel oil, and limonene.

Human health risks from the use of herbicides and adjuvants are analyzed using risk assessment methods currently accepted by the scientific community and the U.S. Environmental Protection Agency. This risk assessment compares herbicide doses that people may get with doses determined likely to be safe to humans based on long-term studies of laboratory test animals. Doses are estimated for people who may be exposed while applying herbicides or by being near an application site.

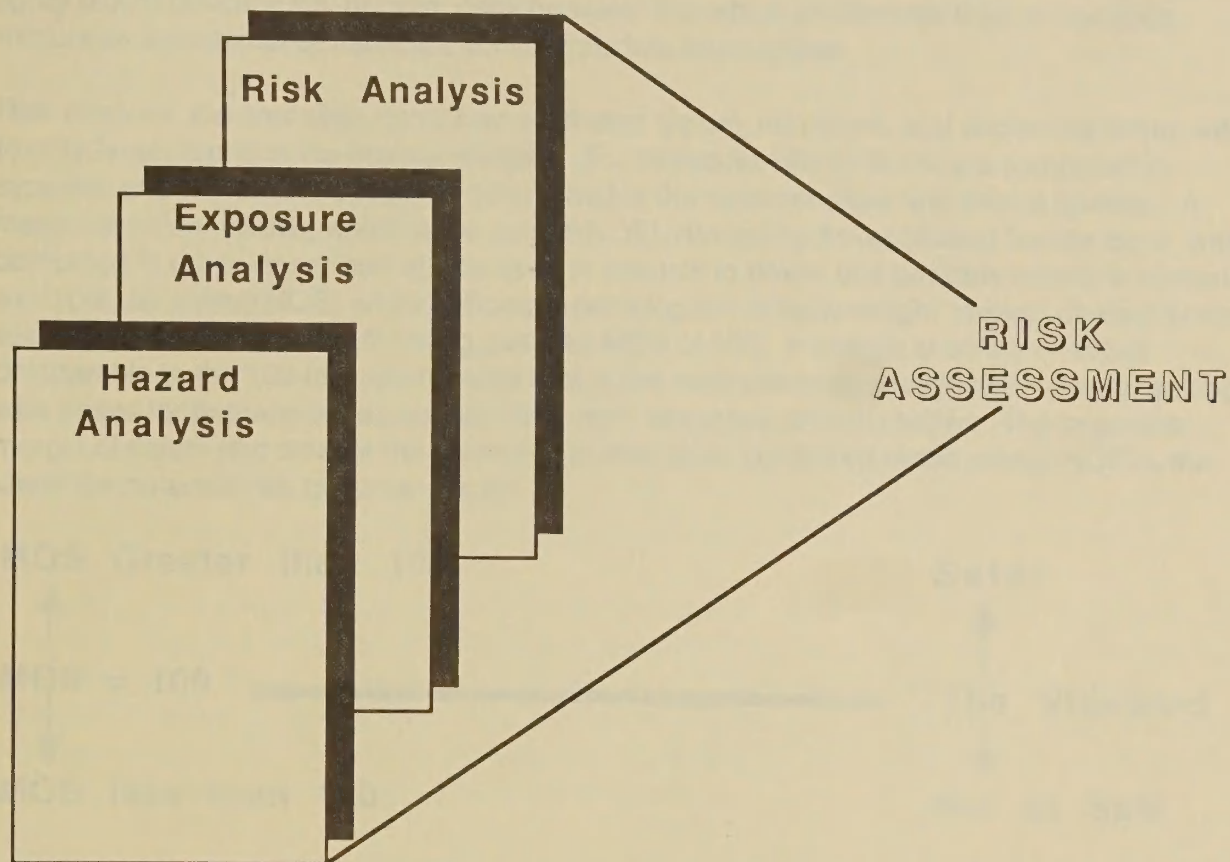
For herbicides that could possibly cause cancer, the risk of a person developing cancer in his or her lifetime is based on animal studies that relate tumor development to increasing herbicide doses. The risk assessment also examines whether any of the herbicides are likely to cause mutations, synergistic or cumulative effects, or effects on sensitive individuals.

Because there is uncertainty concerning many of the data and assumptions used in the analysis, this risk assessment uses a conservative approach that exaggerates estimated risks to human health. This approach involves choosing data and assumptions that ensure risks are not underestimated. For example, assumptions about herbicide applications, movement in the environment, and degradation tend to overestimate doses that workers, the public, and wildlife would likely receive. Toxicity levels used in judging risks are dose levels that caused no systemic or reproductive effects in the most sensitive test animals. The model used to estimate cancer risk uses cancer potencies derived from data on the species and sex that had the highest tumor rate. This conservatism in estimating exposures and in setting and extrapolating from toxicity levels thus exaggerates real risks of the herbicide application program to ensure that it errs on the side of protecting human health.

The analysis of risks to wildlife and aquatic species follows a similar approach to that used for estimating risks to humans. Estimated acute exposures of representative species are compared to acute toxicity levels found in laboratory studies.

RISK ASSESSMENT STRUCTURE AND METHODS

The risk assessment consists of three parts: a hazard analysis, an exposure analysis, and risk analysis.



In the hazard analysis, toxicity studies found in the open literature and publicly available summaries of proprietary data were reviewed to determine toxic properties of each herbicide. Each review included acute (single dose), subchronic (short-term doses), and chronic (long-term or lifetime doses) laboratory toxicity studies that showed effects caused by dermal, inhalation, and ingestion exposures. Benchmark toxicity values that included acute oral LD_{50}'s and systemic and reproductive no-observed-effect levels (NOEL's) were determined for each herbicide. The hazard analysis also reviewed available results of mutagenicity assays and cancer studies and developed cancer potency values for 4 of the 11 herbicides (2,4-D, 2,4-DP, glyphosate, and picloram) that have potential to cause cancer in animals. A cancer potency also was estimated for light fuel oils (kerosene and diesel oil) which contain small amounts of substances that are known or suspected carcinogens. The review also identifies toxicity information that is missing or unavailable for each herbicide. In such cases, judgements were made about toxic properties based on other types of studies.

The exposure analysis estimates herbicide exposures and resultant doses to workers and the public. Exposure scenarios (simplified descriptions of herbicide application operations and of potential route of human exposure) are used to estimate a range of possible exposures (typical, maximum likely, and accident). Typical application scenarios are used to estimate average doses to workers and to nearby members of the public that may be reasonable expected to occur during routine operations. Maximum scenarios are used to estimate highest doses that are realistically expected to occur, and that are not likely to be exceeded except in the case of an accident. Both typical and maximum doses are considered realistic dose estimates. Accident scenarios are used to estimate doses to workers and the public that may result from direct exposure to herbicide spray mix or concentrate, or from drinking water into which a helicopter load of herbicide mixture or a container of herbicide concentrate has been spilled.

Risk analysis, the final step, compares estimated typical, maximum, and accidental doses with toxicity levels found in the hazard analysis. For threshold effects doses are compared to systemic and reproductive NOEL's determined in the most sensitive test animal species. A margin of safety (MOS), which is the animal NOEL divided by the estimated human dose, was computed to relate doses and effects seen in animals to doses and possible effects in humans. For example, an animal NOEL of 20 milligrams per kilogram of body weight (mg/kg) divided by an estimated human dose of 0.2 mg/kg gives an MOS of 100. A margin of safety of 100 is comparable to the 100-fold safety factor that is the most generally recognized value for setting safe doses for humans based on valid long-term laboratory animal studies. The larger the margin of safety (the smaller the estimated human dose compared to the animal NOEL), the lower the potential risk to human health.

MOS Greater than 100 — **Safer**

MOS = 100 — **The Standard**

MOS less than 100 — **Not as Safe**

A person's lifetime cancer risk from herbicides that could possibly cause cancer is based on animal studies that relate the chances of developing tumors to increasing herbicide doses. Risk of cancer from any of these herbicides is based on an estimated total lifetime exposure, averaged to a daily exposure over a 70-year lifetime. The total lifetime exposure used in calculating average daily doses could be to workers exposed over many years as applicators or to the public who may have only a single lifetime exposure. The average daily dose is multiplied by a cancer potency value based on laboratory animal data for tumor incidence at increasing dose levels. These data are adjusted for species differences, body size differences, dose frequency, and duration of exposure.

Analysis of risks to wildlife and aquatic species is similar to the human health risk assessment. The basis for comparison, as suggested by the U.S. Environmental Protection Agency, is the species LD_{50} or LC_{50} (median lethal concentration). The Region 8 risk analysis uses laboratory toxicity data on species most closely related to a series of wildlife and aquatic species representative of the national forests of the Southeast U.S. Because all of the herbicides examined show no tendency to bioaccumulate, long-term persistence in food chains and subsequent toxic effects, such as those that have resulted from the use of persistent organochlorides, are not considered a problem and are not examined in the risk analysis.

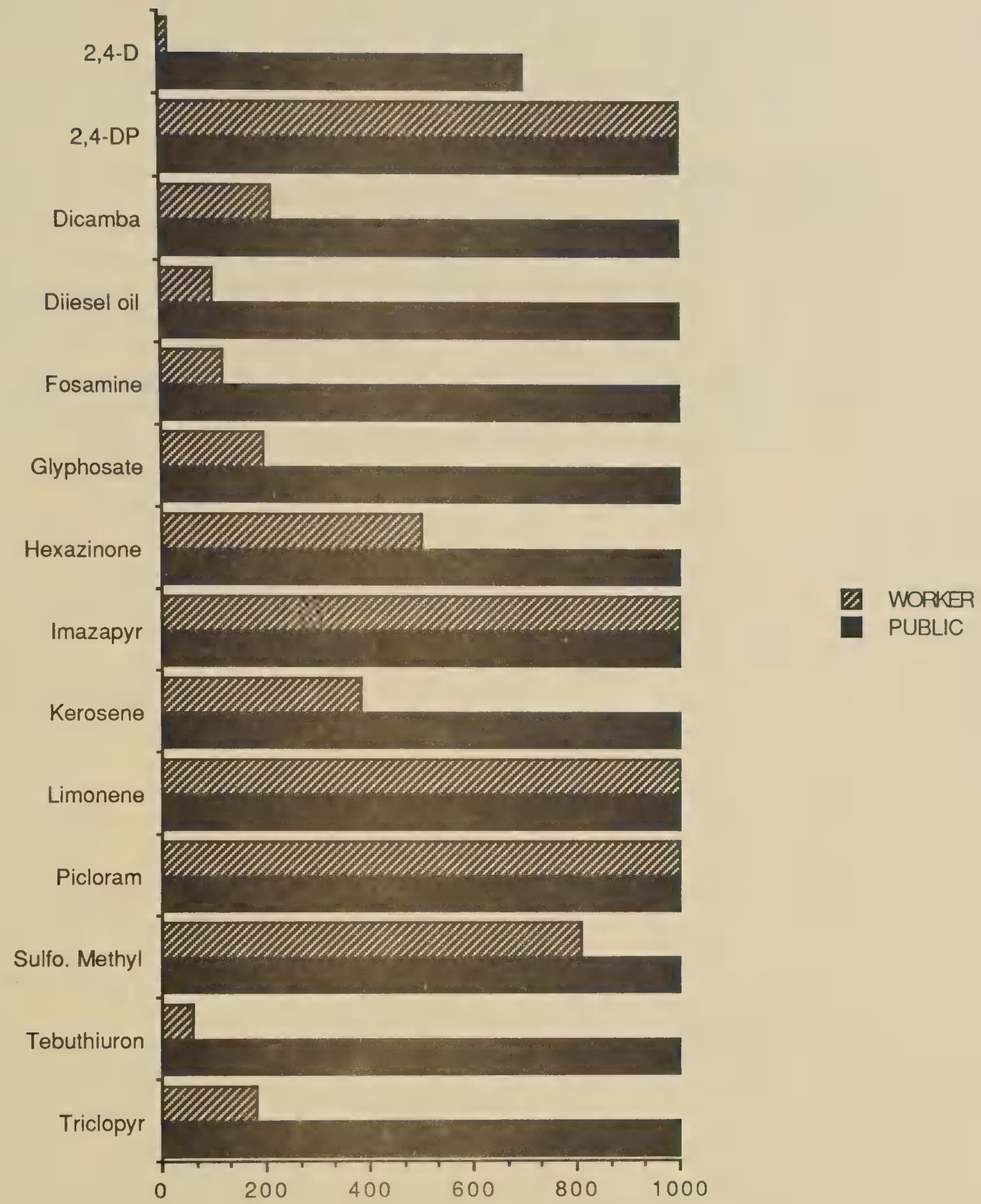


Figure AS-1. Lowest MOS (margin of safety) under typical conditions. All values shown as "1000" exceed that number (some, such as picloram and imazapyr, exceed 10000)

the majority of chemicals. The highest relative risks to wildlife are from 2,4-D and 2,4-DP, but even these risks are only moderate. Local populations of small mammals, small birds, terrestrial amphibians, and reptiles may be adversely affected by broadcast applications if large areas, relative to their home range, are treated. However, any effects on populations are expected to be temporary. Populations of larger mammals and birds as well as domestic animals are not likely to be affected at all. Available data suggest that aquatic species are not at significant risk of adverse effects from either typical or maximum exposures to any of the chemicals evaluated.

Animals exposed to 2,4-D, 2,4-DP, dicamba, tebuthiuron, or triclopyr in accidental spills on land are likely to be seriously affected and may die. Serious effects or fatalities are less likely with the other herbicides. Aquatic species directly exposed to high concentrations, such as an accidental spill in water, are likewise liable to be seriously affected and may die. Based on accident scenarios, significant acute effects on aquatic organisms would be expected for spills of 2,4-DP, diesel oil, Roundup (glyphosate), kerosene, limonene, and triclopyr ester. In both terrestrial and aquatic accident cases, effects should be highly localized and short-lived. Spill cleanup on land should minimize the possibility of long-term and widespread effects. Dilution and spill cleanup in aquatic environments should likewise minimize effects.